NASA SBIR/STTR Technologies
"Improved Design of Radiation Hardened, Wide-Temperature Analog and Mixed-Signal Electronics"

Proposal No.: X1.03-9438 Contract No.: NNX11CB99C

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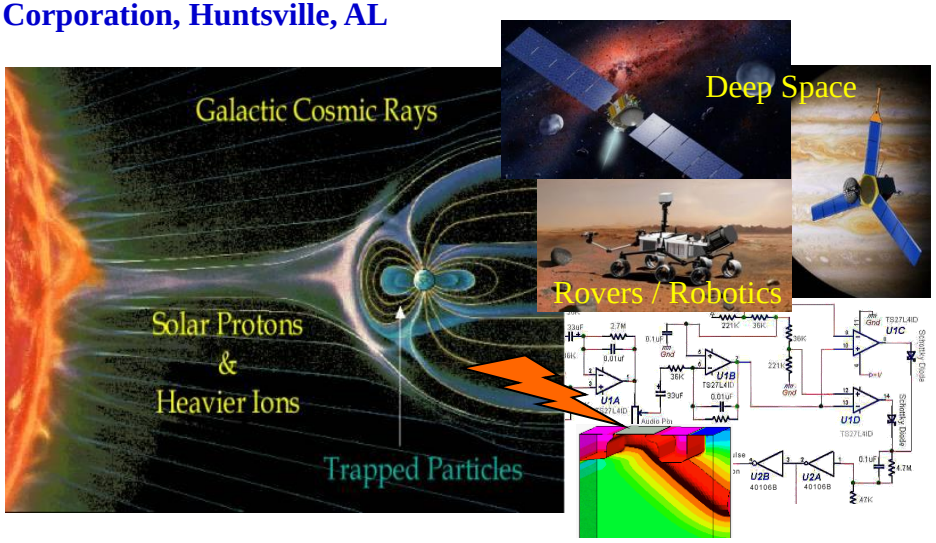
Identification and Significance of Innovation

- **NASA space exploration missions and projects** need reliable electronics that can survive and operate over a **wide temperature range (-230ºC to +130 ºC)** and **high radiation** levels.
- There is significant **need to develop & test new rad-hard wide-T** circuits and **robust CAD tools** to facilitate **design and analysis**.
- Innovations: (a) **Improved modeling/design tools,** coupled with Cadence and Geant4, enabling **innovative mixed-mode** analysis of radiation effects in analog/mixed-signal systems in extreme temp.; (b) **Novel Rad-Hard designs** (new concepts, prototype circuits, experimental verification) of SiGe HBT Analog/Mixed-Signal ICs.
- **Estimated TRL** at the beginning: **2,** and at the end (of Phase II): **4**



Technical Objectives

◆ Design, validate, and demonstrate RHBD ICs in SiGe BiCMOS technologies for extreme environments. ◆ Enhance CFDRC's physics-based modeling tools (NanoTCAD, Mixed-Mode) for predicting electrical performance and radiation response of space electronics in extreme temperature range, to support RHBD design.

Work Plan

Phase I: ♦ Upgraded CFDRC's NanoTCAD tools with new semi-conductor physics models for extreme low temperatures ♦ Performed first-ever mixed-mode SEE simulations of analog circuit (BGR); ♦ Evaluated different simulation approaches (current injection vs. full mixed-mode) – derived guidelines for future SEE simulations.
Phase II: ♦ Developed new RHBD strategies for SiGe BiCMOS technologies ♦ Demonstrated and validated the improved TCAD models/tools for extreme environment analyses, including displacement damage calculations in Phase II-E ♦ Fabricated RHBD ICs, tested for rad-hard performance, and delivered to NASA.

NASA and Non-NASA Applications

• **NASA Applications:** Radiation-hardened and wide-temperature analog and mixed-signal circuits for avionic systems used in the NASA space exploration missions, such as Europa Jupiter System Mission, Titan Saturn System Mission, Venus In-Situ Explorer, sample return from Comet, Asteroids, lunar and Mars exploration.

• **Non-NASA Applications:** Wide range of analog and mixed-signal circuits in space electronics, including DoD space systems (communication, surveillance, missiles) and commercial satellites.

Firm Contacts

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